FAILURE ANALYSIS GROUP
SECTION 514

Announces the Recent Installation of a New Analytical Capability

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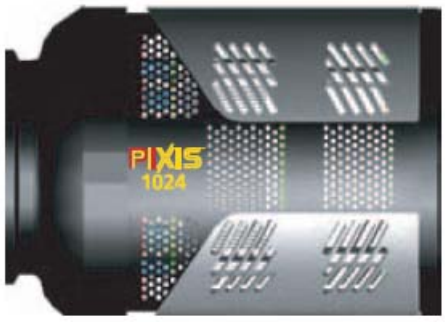
PHOTON EMISSION MICROSCOPE
(PEM)

DESCRIPTION

PEM is designed primarily to detect the photon emission (400 to 1100 nm range) associated with device failure caused by current leakage through the dielectric isolation film materials used in multi-layered semiconductor structures, such as simple IC's and complex VLSI, ASIC, and FPGA devices. These structures commonly include silicon oxide and other insulation layers.



By combining optical microscopy with the latest in computer image processing techniques and up-to-date Cooled Back-Illumination CCD camera technology, PEM is able to image the extremely faint light emission accompanying leakage current conditions in dielectric films on silicon substrates. This new technology allows the Failure Analysis Group to inspect and accurately pinpoint the location of various types of dielectric defects in a much shorter integration time and with much more photon sensitivity in comparison with the photon intensified low light camera in older EMMI systems.

PEM is comprised of an optical microscope fitted with a low light-level imaging system housed in a light-proof enclosure. Under the microscope, a stage holding the device under test (DUT) provides movement capability in the X and Y directions. The stage also enables Z-motion to optimize focusing. Four optical lenses are available: 5X, 20X, 50X, and a 100X lens with extra long working distance.

In operation, the system integrates the photons emitted from the DUT, and the defects are then displayed on a CRT as "bright spots" superimposed on an image of the DUT, which then readily reveals the exact location of the photon emission in the semi-conductor device. With this information, failure analysis engineers can locate the failure site on the DUT and determine the likely cause of failure by consulting the composite layout of the device being tested.

The PEM test is nondestructive and the photon emission at the oxide defect can be observed through the glass passivation and in certain cases under the metallization. PEM can detect photons emitted from oxide defects having leakage currents as low as 0.5 micro-amps.

Since PEM in general is a sensitive photon detector, it can be considered for use as both a failure analysis tool, and as an investigative tool on parts that emit photons as a consequence of normal operations.

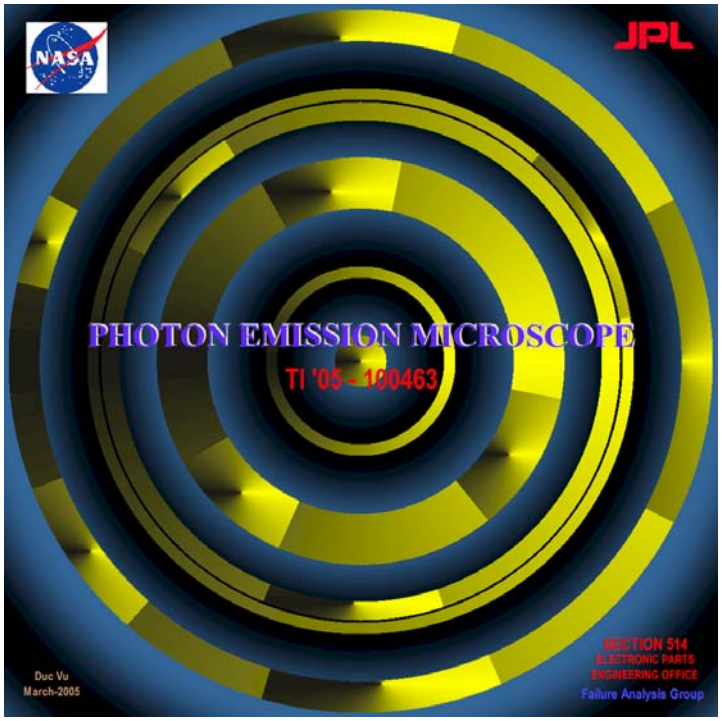
APPLICATIONS

The types of failures found by PEM include the following:

- Process or structure induced failures (i.e. oxide breakdown at the corners of features)
- Random failures (oxide breakdown at random locations)
- ESD damage (usually associated with oxide damage)
- Latch up condition
- Impact of hot electron injection
- Saturated transistors ("legal" or "illegal")
- Optoelectronic failures

In addition to these, you are invited to explore any other potential uses of this new analytical technique for your specific applications, such as for example, "charge-coupled-devices" (CCD) and custom chips.

We also can design custom software to incorporate the PEM with your instrumental setup to obtain the photon image at the right condition (i.e. time, power, and temperature).



INFORMATION

For further information, visit the PEM facility at Bldg. 300 Room 110, or to make an appointment, contact the Failure Analysis Group at extension 4-9529, or Duc Vu at 4-2019.